Development of a Deaeration Model for Stirred Tank Analysis in Moving Particle Simulation Method

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ABSTRACT

We need to analyze high viscous fluid flow in a stirred tank for the manufacturing process of plastics, where removal of by-product gas is required. In the present study, a gas bubble model is developed and verified to be used in the Moving Particle Simulation (MPS) method [1, 2].

To analyze high viscosity fluid flow, the viscosity term is implicitly solved. The implicit calculation agrees well with that of the explicit calculation.

Assuming many small gas bubbles dispersed in the high viscosity fluid, we set independent unknowns as number and mass of the gas bubbles involved in a fluid particle. The average bubble diameter and the void fraction are obtained as dependent variables by using the equation of state. The independent unknowns are transported with the fluid because the bubbles are assumed to move mainly with the liquid flow in Lagrangian description. This motion is simply represented by the particle method because keeping the independent unknowns at each moving particle represents the Lagrangian description. Relative upward motion of the bubbles due to buoyancy is considered by the exchange of the independent unknowns. Part of an unknown at particle i is distributed to the neighboring upper particles j, where the upward bubble velocity satisfies the steady-state value represented by Stokes' law. When the fluid particles reach the free surface, removal of gas bubbles takes place with an assumed time constant. This bubble model is verified by simple problems.

Using the above gas bubble model, fluid motion in stirred tanks is analyzed. Removal of by-product gas is successfully evaluated using the MPS method.

REFERENCES

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